Time, and Changes Over Time: A Child's View

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Abstract

This essay is about children's *sense of time*. It discusses how youngsters of different ages experience and represent temporal events. Questions addressed include: Do children think of time passing as a dot that moves along a line or, rather, as a path that unfolds as they themselves move along? Alternatively, do they think of time as a cycle of repeating occurrences? From when on can children project themselves into the future, and how do their views of the future, and past, affect how they perceive the present? Lastly, how do children use time itself as a reference, or dimension, to understand *changes over time*? In other words, how do they think of the *genesis* of things, over time? What is their conception of how things evolve, or regress, or plateau, in the light of what has occurred in the past, and of some predicted future? I draw from research by James, Piaget, Decoly, Montangero, and Pons to shed some light into the amazing journey that leads youngsters to the progressive mastery of diachronic thinking.

Introduction

Children have their own experience of, and ideas about, *time*: time passing, times past, and times to come. In this essay, I discuss *how children of different ages, or developmental stages, grapple with—and represent—temporal events*. My assumption is that, indeed, children develop a growing *sense of time* as they themselves grow older, and they do so very actively! I draw from work by James, Piaget, Pons, Montangero, and Tryphon to shed light into the amazing journey that leads youngsters to the progressive mastery of diachronic thinking.

I touch upon three related areas constitutive of a child's growing sense of time, or pre-requisites to a child's diachronic thinking: Children's perceptions—and conceptions—of duration; Children's abilities to project themselves—and other things— in time; and children's conceptions of changes over time. In each area, I highlight some of the major developmental breakthroughs, by roughly grouping children into 3 age groups: Babies (0-2 years); Little kids (2-8 years); and Big kids (8-12). Needless to say, in the space imparted, I will only scratch the surface of how each group comes to master and understand time. I nonetheless hope to provide some insights into children's achievements and, more important, into the hidden drivers which shape the children's constructive process.

Pre-requisites to a child's diachronic thinking

1. Children's perception of duration

Understanding temporal order, and intervals

Dissociating time, space, velocity, movement

The emphasis here is on time itself as an object of knowledge, and time—also referred to as *duration*— is defined "objectively"(or the way scientists would), as a function of speed versus space [D= V/T]. I draw from research by Piaget and his colleagues to illustrate how children think of duration, temporal order and intervals, and how they learn to progressively conserve duration, and dissociate time from space, and space from speed and motion.

2. Children's abilities to project themselves—and other things—in time

Mentally "traveling" along a time line

Speeding up and slowing down things in one's mind

[while] understanding the invariance of [objective] time

In this case, the stress is on children's abilities to transcend the *here-and-now* contingencies proper to sensor-motor intelligence, and to project themselves – and other things – in time. Important here is the notion that how we remember the past and foresee the future necessarily "contaminates" how we look at the present (James, W., 1890). Experientially speaking,, that is, there is not such a thing as a pure present, even if the present is all we have access to through our senses. As an example, think of what happens in our minds when we listen to music: without embedding incoming sound bits into larger streams, or auditory "gestalts", music itself dissolves. The same holds true when we watch TV or listen to a speaker. I draw from research by Decoly and Piaget on time and aging to illustrate how children of different ages project themselves –and other people and things— in time.

3. Children's conceptions of *changes over time*

Using time as a constant to detect "uneven" development

Viewing present situation as one moment – or state –

within a temporal , dynamic, or evolutionary process

In this last part, the focus is on the *genesis* or evolution of things, as they themselves undergo changes over time. I draw from research by Montangero and Pons to illustrate how children come to use time [or their diachronic intuitions] as a dimension, or referent, to understand changes over time. In other words, I wonder if and when children can infer how things evolve, or regress, or plateau, in the light of what has occurred in the past, and of some predicted future? This ability, referred to as "diachronic approach" in its adult form (Montangero, 1996, Pons and Montangero, 1999), further consists of predicting *how* a person's, object's, or system's states and behaviors will be affected as time goes by. What's at stake here are changes that are dynamic, uneven, and systemic, i.e. *changes of changes*, such accelerations, U-shapes, or regressions.

The foundations of diachronic thinking in children — Developmental trends

Piaget's clinical interviews with developing children convinced him that the concepts of time and space arise gradually from how the child senses and makes sense of her own motion relative to the motion of objects in her surrounds.
As mentioned earlier, I roughly cluster the children into three age groups to provide a window into their growing sense of time, from babyhood to pre-adolescence. Groups are described as follows:

Babies [0-2] …….. *Immediate time*

Little kids [2- 8]…… *Times past and times to come*

Big kids [8 - 12]…….*Evolving times / revolving times*

In each group, I show how children use their diachronic intuitions to make sense of dynamic event spaces and, conversely, how they use their budding senses of space, object permanency, agency, and causality to get a better handle on time itself. As Piaget so clearly demonstrated, all the above categories [space, time, causality, agency, and object permanency] appear and grow in parallel, and they feed one another to form an underlying matrix, or structure, that organizes and drives a child's interactions with—and understandings of—the world.

To put it even more simply, a child's experience is always originally undifferentiated.
It takes years for a child to disentangle the spatial, temporal, intentional, and causal dimensions, and to conceive of each separately.

Note that the notion of object permanency has to do with understanding the identity of things beyond surface appearances and changes, while agency and causality have to do with understanding the "logic" of antecedents and consequents, in terms of what (or whom) impacts what (or whom), and why. All involve time because time is at the heart of each of them.

Babies [0-2] ……..immediate time

"At its departure point, time is solely intermingled with the impressions of psychological duration inherent in attitudes of expectation, effort, and satisfaction, in short with the activity of the child herself" [Piaget, 1952. p. 363].

As we know, babies live mostly in the present or in the "here-and-now" of things. Hence little room for time or diachronic thinking at this age. It is only with the apparition of the first evocative memories and the first anticipations of things to come that diachronic thinking (or thinking in time) gets under way. In Montangero's words:

"*We can identify the beginnings of diachronic thinking in babies who stop crying when they hear the door to their room open or who are overcome with joy when they see their bottle being prepared"* (Montangero, 1996, p.6)

On the other hand, we also know that, even before birth, human infants become well attuned to their mother's heartbeat and breathing pattern and that, once born, they live much of their lives at the pulse of their own internal clocks. The babies themselves "are" clocks, one may say, instead of having a sense of one!

This being said, babies are quick to put to their advantage their built-in "rhythm machines" and, before we know it, they use them to get other people, and ultimately themselves, in the flow and in the beat of their own needs and wishes. Early on, that is, babies take on an active role in regulating incoming signals to keep a comfortable zone between over- and under- stimulation. This infant version of *flow* functions as follows: If too much input, then shut down or slow down. If not enough, then open up or "get going". Similarly, babies like to engage in early social turn taking or mirroring games, as well as in pre-verbal dialogues and peek-a-boo games. These social games help infants to tune into someone else's rhythm, while at the same time, negotiating [in action] a *place*— and a *tempo*—for themselves in the transaction. As they reach 9 to 12 months of age, most babies are able to pace themselves, tune into the pace of others, and "negotiate" changes in pace in order to optimize their level of comfort. The same goes for proxemics, or the art of distancing (or mutual positioning)!

In sum, while babies' initial sense of time does not expand much beyond their own sensori-motor activities, they still develop a solid practical mastery, and subjective sense, of time during their first years. This sense of time emerges from infants' abilities to maintain or release tensions associated with expectations, effort, and satisfaction of basic needs, like hunger, comfort etc. (Piaget, 1952). As they reach their second birthday, most children have acquired a solid *knowledge-in-action* about time, space, object permanency, agency, and causality. They have a handle on the "logic" of antecedents and consequences, and they coordinate means and ends when achieving simple tasks. I cannot emphasize strongly enough that all these categories are intricately related, and co-constitutive of a child's evolving worldview, of which time is a part.

Little kids [2- 8]: Past and future times

The end of the second year marks a major breakthrough in a child's growing sense of time. With the beginning of the symbolic function, children start to talk and to listen to stories. They engage in pretend and role-play, and they love to leave traces behind and scribble on any possible support. These newly acquired interests and capacities are surface manifestations of two deeper changes, relevant to our discussion about time.

1. At the age of two, a child's experiential field expands *beyond the here-and-now* to *include there-and-then***.** The child now enacts things of the past, and imitates people in the absence of a model [differed imitation]. The child also represents things, using symbols. Most important, s/he can now imagine how thing *could be* [s/he creates fancies, envisions alternative ways] or *will be* [s/he foresees the outcome of events], thus establishing a dialogue between actualities and possibilities.

2. At around the same age, *a child's action-in-the-world [direct experience] becomes internalized, or mediated through thinking [mediated experience].* As a consequence, a previous action can now be used as an "object-to-think-with" (Papert, 1993). More to the point, the child can choose if she wants *to act* or *not to act,* i.e. express herself or "hold" things in her mind. A two-years old can, if needed, delay gratification. S/he plans ahead and s/he starts using words, tools, and other detours and mediations to get things her way

Important here is the notion that, from age two on, a child simultaneously *internalizes* her action and *externalizes* her thinking. In other words, s/he mentally re-constructs the knowledge-in-action that s/he has previously acquired. Conversely, she externalizes, or objectifies, her lived and felt experiences through symbol(or tool)-use, thus making them tangible and shareable. It will take several years for this dual process of internalization-abstraction / externalization-materialization to be fully mastered.

As the terms "here and now" and "there and then" suggest, the dimensions of time and space are intricately related. In other words, without a sense of space and time there is no conception of change or stable states, and without efficacious causality and object permanence there is no way to locate and order objects and movements within a spatio-temporal framework.

Since our focus is on time, it is however useful to conceptually break down these psychological units into their distinctive spatial or temporal components.

Moving from "here to there"— or mastering space —enables a child to engage in "ever wider" detours while keeping her bearing. It involves finding one's way back by reversing direction. Mastering space also involves the abilities to change the scale of things in one's minds [EX: Lilliput and Gulliver], and to invent the tools and techniques to facilitate navigation and orientation in space [Ex: leaving breadcrumbs behind, as in Hansel and Graetel, or unraveling a red thread, as Arianne in the labyrinth]

Moving from "now to then" —or mastering time— enables the child to evoke things of the past and anticipate what's to come. It involves understanding relations between before- and after, or the "logic" of antecedents and consequences. Understanding time also involves projecting oneself in time (I was daddy, now I am the baby), and speeding up and slowing down events in our mind (slow motion and fast play). It further requires the abilities to build clocks and other devices to measure time, or check how long things take.

The big difference between time and space is that, unlike space, time is irreversible: We cannot go back in time, except in our minds. Much of a young child's achievement in diachronic thinking has to do with *understanding the irreversible nature of time***,** and certain change over time (like erosion, aging, times of causes and times of effects). The overall changes that occur with the emergence of the symbolic function have major implications from a temporal perspective. Let me mention but a few.

Example 1: Engaging in any activity that takes more than two step to be completed, like getting dressed or feeding a doll, requires that the child does things in a certain order: "I first do this, then I do that, etc." It is around the age of 3 that most children become able to organize a series of steps into a simple "scripts" (Nelson, In Montangero, 1996, p. 6).

Example 2: Planning ahead further requires that the child reverses the order of things, proceeding backwards from the goal. Thus, in addition to "first I do this, then that" (constructive order) the child has to understand that "if I want to achieve step 2 [EX: put on shoe] I'll have to do 1 first [EX: put on socks]" (teleonomic order). . These two orders are simultaneously at play as a 3-4 years old coordinates means to achieve a goal in a simple script (Nelson, In Montangero, 1996, p. 6).

Example 3: Being able to tell or listen to stories requires that a child grasp the stories' causal, temporal, and narrative sequence ["once upon a time, then, they lived forever happy thereafter"]. Research shows that by the age of 5-6, children can order photographs to represent successive moments in the course of a falling object (Piaget, in Gruber and Voneche, 1977, p.551-557). And it won't take long until they can tell a tale with a beginning, a middle, and an end (Montangero, 1996, p. 6).

Example 4: Remembering the past and foreseeing the future unlocks a child's potential to reason on antecedents and consequences, and to question the origin of things, as well as their destiny. It is around the age of 3-5 that children become obsessed with questioning the origins or things, including themselves, and start wondering about the irreversibility of time in instances such as aging or death (Carey, Gellman, In Montangero, 1996, p. 6).

Example 5: Research by Piaget and Decoly on children's understanding of aging further indicates that to a 5 years old, growth and aging are one and the same things (Piaget and Decoly, In Gruber and Voneche, 1977, p.563-569). In essence, to a 5 years old, not all people age at the same rate, and once they are grown ups, people don't age anymore: they plateau. Most striking, to a 4-years old, some people (especially older folks who are not part of the child's family) have never been babies before!

To conclude, between the ages of two and eight, a child progressively masters and represents *times past and times to come*: a lengthy process of "objectifying" and abstracting time. The process involves moving away from felt duration to build an external standard of time (that is measurable using clocks], and isolating time from its spatial, narrative, and causal underpinnings. Once this developmental task achieved, the child is now ready to use time itself as a referent to make sense of changes over time.

Big kids [8 -12] Evolving times , revolving times…

Starting at the age of eight, a child's experiential field further expands to include the ability to reason in a world of possibilities. That's when diachronic thinking grows full potential. I mention three aspects of diachronic thinking that undergo considerable development between the ages of 8 and 12: qualitative transformation, temporal dissociation, and dynamic synthesis. These aspects, introduced by Pons and Montangero, reflect the different ways a person thinks situations may change over time, conceives of the temporal succession of several interconnected changes, and is able to grasp a succession of states as a totality [Montangero, Pons, 1999).

1. <u>qualitative transformation:</u> is a term used to stress that changes over time can be uneven, i.e., that rates of growth too can change. More important, it points to evolutionary processes in which more than one variable changes over time, instead of just one — for instance, the growth of a tree, or a person, is an increase of size over time, but it is also a change of the shape of the tree, or person.

   Experiments by Jacques Montangero and by Francisco Pons, indicate that up to 8 years of age, children tend to describe changes as a quantitative increase of a single variable, whereas at age 11-12 they can handle the growth or co-evolution of different variables. Similarly, research by Tryphon on children's views of how younger kids draw a human figure shows the following: Up to age 8, children draw ever smaller but similar figures to indicate how young kids would proceed. At about age 7-8, the children start to simplify their own ways of drawing to show how younger kids would proceed (Tryphon, 1994, Tryphon and Montangero, 1992).

2. <u>temporal dissociation:</u> is a term used to emphasize a person's ability to represent independently the course of two interconnected but non synchronous events —and their mutually resulting effects-over time. For instance, if one's skin gets darker as the sun shines brighter, it doesn't mean that it gets paler again, in the evening, as the sun goes down. Our tan goes back slowly over time. Up to age 9 children tend to think that effects co-vary with causes. In contrast most 11-12 years olds can easily imagine that the color of the skin needs not vary simultaneously with the intensity of its cause (Pons and Montangero, 1999. p.194).

3. Dynamic synthesis: is a term used to stress a person's ability to form a meaningful whole from the successive steps that punctuate a given change over time. For instance, in telling a story, children up to age 8-9 tend to mention each step, one after the other, and cannot easily summarize. Instead, a majority of 11 and 12 year-olds can describe the whole set of steps with a single noun phrase.

Research by Pons and Montangero shows that all the components of diachronic thinking develop simultaneously, and that all rely upon capacities of representing and understanding changes over time. This simultaneity is not, according to the authors, determined by a general level of operatory thought—which, in their view, is more general and a-temporal. It is however related to some logical operations, such as seriation, reversibility, differentiation and coordination of variables, which contain a temporal dimension (Pons and Montangero, 1999).

To conclude,

Time is no easy category to grasp, either for kids or scientists. There are several reasons to this.

1. *Time is both a contruction of the mind and a dimension of the world*. While time flies by *at its own constant rate* and *beyond our will*, and thus exists in the world independent of our perception, it can only be apprehended through personal experience. What's more, unlike spatial configurations, temporal sequences can never be perceived at a glance, which implies that every moment away from the present involves a mental reconstruction. As soon as I speak, the word it is gone. As soon as I listen, the sound is gone. When I look or touch, however, a static arrangement, if small enough, can be "held" as a totality.

2. *Time is both psychologically primordial and hard to abstract, or "grasp" at a conceptual level*. Early on, babies develop a strong sense of rhythm, or 'felt duration" (Piaget, 1952). While psychologically primordial, this inner sense of time, which we all share, isn't always of much help when it comes to reasoning in time. This difficulty seems to transcend development itself. Boldly put, it takes a scientist to isolate speed and duration from their spatial and causal grounding, and to flawlessly—and flexibly—think in time! For the rest of us,

3. *Time is invisible*. Throughout development, people's sense of time (time as lived) is at odds with our shared concept of "real" time (time *as is*) because duration itself is an emergent phenomenon. As Piaget put it: "time is nothing else than the forming of relationships between the events which fill it" [Piaget, CR. p362 b]; "the constitution of time itself cannot happen without its spatialization" [piaget, CR. p. 384]. In sum, time is invisible to us because it is co-constitutive of space, numerosity, speed, and object permanency, and because it manifests itself only via the events that fill it.

How to deal with time that is "invisible? — Just plain folks versus scientists!

No doubt, our mastery of time gets better as we grow older. Yet, time remains a hard to handle category, independent of a person's age. To cope with time, even adults generally adopt two basic strategies, or heuristics. A first strategy is [our tendency] to *freeze time*, as well as movements in time. In Piaget's words: "space is a still of time, and time is space in motion". A second strategy is [our tendency] to break down a temporal continuum by giving it a pulse or a 'beat'. *Discretizing* allows us to 'count" temporal intervals, or durations. Both strategies have the advantage of grounding an otherwise invisible and ephemeral temporal flow in ways that can be grasped and measured. Both have the unwanted effect of embedding time so deeply into their "host" dimension [space, frequency] that our minds can no longer conceive of time independently…

Unlike just plain folks, scientists look at their object of inquiry (in this case time and people's sense of time) with the purpose of bringing empirical evidence and theoretical rigor to understanding, and ultimately correcting, people's "distorted" notions of time. Many ingenious experiments have been invented to this effect.

In "the perception of duration" James refers to a study by Wundt to validate his own view that all people distort time, and that they do so in systematic ways, and probably for good reasons. In a nutshell, the experiment shows that 1. As we grow older things appear shorter to us; 2. As we become bored things appear longer —yet only longer at first, and short thereafter; and 3. If we enjoy ourselves, things appear shorter —yet shorter at first, and long thereafter. These results are remarkable for they speak to our abilities to use *forgetting* and *fast forwarding* (mentally speeding up time) to rid ourselves of things unimportant and, conversely, to use *remembering, detailing*, and *slow motion* (mentally slowing it down) when things become important to us (James, 1890).

Piaget, on the other hand, defined time "objectively" as duration and designed many experiments to study how children, at different ages, make sense of the scientist's definition itself. In a first series of experiments, miniature cars are made to race on parallel tracks. Cars always start jointly. In some cases, one vehicle runs faster on a shorter path [breaking spatial correspondence]. In other cases, both vehicles travel at the same speed, yet one continues after the other has stopped [breaking simultaneity of arrival / departure]. Piaget and his colleagues also studied what happens if vehicles run on circular tracks. In this case, starting and arrival times match but the outer ring is longer, thus a mobile has to go faster to catch up. Designed to study kids as scientists, these studies, ironically, became the best testimony of children's pre-scientific thinking. To Piaget, children's insights are highly adaptive even if they break down in "tricky" cases, especially designed to push the envelope of our habitual ways of thinking.

While James studied subjective time, at all ages, Piaget was interested in how children, at different ages, interpret the scientist's definition of time. And how they construct their own. Both approaches are needed to enrich our understanding of *how* children come to master time time, as they grow older, and why time remains a hard to handle dimension, even as we are grown up

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